CORRECTIVE MEASURES STUDY
WORK PLAN

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Permittee: Solutia inc, and Flexsys America L.P.

Permit No.: WVD 039990965

Facility Address: No.1 Monsanto Road
Nitro, West Virginia 25143

Name: Anthony C. Tuk

Title: Solutia
Nitro Coordinator
Manager Remedial Projects

Signature: Anthony C. Tuk

Date: March 15, 2001

CORRECTIVE MEASURES STUDY
WORK PLAN

SOLUTIA INC.
Nitro, West Virginia

March 26, 2001

Prepared for:

SOLUTIA INC.
1 Monsanto Road
Nitro, West Virginia 25143

Prepared by:

ROUX ASSOCIATES, INC.
1222 Forest Parkway, Suite 190
West Deptford, New Jersey 08066

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1.0 INTRODUCTION

1.1 Purpose

The purpose of this Corrective Measures Study (CMS) Work Plan is to provide a general approach to implementing the CMS activities for the Solutia Inc. (formerly Monsanto) facility located in Nitro, West Virginia as shown on Figure 1. The CMS is required by the facility's Resource Conservation and Recovery Act (RCRA) Corrective Action and Waste Minimization Permit (USEPA ID No. WVD 033990965, Part II, Section D). This Permit was issued on November 2, 1990 by the United States Environmental Protection Agency (USEPA).

Environmental investigations of the facility's fourteen solid waste management units (SWMUs) that are subject to RCRA Corrective Action were completed in 1994, and findings were presented in the approved RCRA Facility Investigation (RFI) Report and Stabilization/Corrective Measures Plan (SCMP) dated May 5, 1995. Additionally, an Addendum to the RCRA RFI and SCMP was submitted to the USEPA on August 7, 1995. As a result of the environmental investigations detailed in these documents, a Stabilization/Corrective Measures Study (SCMS) Report dated February 29, 1996 (revised) was prepared and approved by the USEPA on July 1, 1996.

A Stabilization/Corrective Measures Effectiveness Report (SCMER) dated January 25, 1999 was submitted to the USEPA. The SCMER addressed the implementation of the stabilization/corrective measures detailed in the SCMS. Furthermore, the SCMER documented remediation efforts for ground water and light non-aqueous phase liquids (LNAPL) as well as closure activities associated with previously closed surface impoundment units. The SCMER also described the implementation of facility waste minimization projects in progress at the time. Upon completion of the SCMER review, the USEPA prepared a comment letter dated October 25, 1999 and, as a result, the Response to USEPA Comments on Corrective Measures Effectiveness Report (Response Report) dated May 12, 2000 was submitted by Solutia Inc. to the USEPA.

The USEPA's review of the Response Report resulted in multiple meetings and exchanges of correspondence. In letters dated August 16, 2000, and January 18, 2001, the USEPA requested that a CMS be implemented, and indicated that the CMS process could be completed in a phased approach to prioritize the activities. This CMS Work Plan was developed pursuant to USEPA's letter dated January 18, 2001. A copy of the letter is provided in Appendix A. Additionally, the CMS Work Plan was prepared in accordance with the guidelines provided in USEPA's publication "RCRA Corrective Action Plan, OSWER Directive 9902.3-2A, May 1994".

The CMS Work Plan is organized as follows. Section 1.0 is an introduction presenting the overall Work Plan purpose. The objective of the Work Plan is discussed in Section 2.0. The Corrective Measures Alternatives are discussed in Section 3.0. The Approach to the CMS evaluation is presented in Section 4.0. The Outline of the CMS Report is summarized in Section 5.0. The Project Team and the Schedule are discussed in Sections 6.0 and 7.0, respectively.

2.0 OBJECTIVE

The objective of the CMS activities is to ensure that the site continues to be maintained in a fully stable environmental condition. To this end, the facility is restoring the process sewer system component of the facility sewer system. As confirmed by the USEPA's letter dated January 18, 2001, this project "would be adequate to eliminate future releases of process wastewater from the unit." The facility will continue to focus on selected SWMU–specific stabilization measures and to address the site-wide residual concentrations in ground water.

As discussed in previous reports, major physical and/or closure activities were conducted on site to address impacted soils. These activities included:

- regrading and installing a gravel cover at the Past Disposal Area (PDA) including areas of the Tepee Incinerator, the Niran Residue Pits and the Aboveground Equalization/Storm-Water Surge Tanks;
- decommissioning and removal of the Tepee Incinerator;
- regrading and capping the City of Nitro Dump;
- closure of the Waste Pond;
- closure of Basin A3 and Digester of the Wastewater Treatment Plant;
- closure of the Surge Basin;
- closure of the Emergency Basin;
- closure of the Equalization Basin; and
- closure of the Limestone Bed.

As a result of the aforementioned completed activities, the remaining soil Area of Concern (AOC) acting as a potential source of ground-water contamination is the northern portion of the PDA that contains LNAPL in the form of separate-phase kerosene.

The specific objective of the CMS Work Plan is to focus on the remaining soil and ground-water issues on site by:

- Providing engineering controls (asphalt cap) in the northern portion of the PDA containing LNAPL (the LNAPL Area) as depicted on Plate 1; and
- Addressing the site-wide ground-water conditions.

By capping the LNAPL Area, the threat of LNAPL mobilization will be eliminated and the remaining issues with respect to corrective measures will be limited to ground water.

Each of the objectives is further discussed below.

2.1 Engineering Controls at the Past Disposal Area

The PDA is the site of the former Tepee Incinerator, the Niran Residue Pits and the Aboveground Equalization/Stormwater Surge Tanks. However, based upon the previous environmental investigations performed in this area, the only remaining soil AOC appears to be the LNAPL Area. Because of the potential for LNAPL mobilization and its continual contribution to the ground-water contamination in this area, asphalt capping of the LNAPL Area is hereby proposed. The cap will provide a barrier against vertical percolation of precipitation (rain and snow) and will prevent the LNAPL from mobilizing. Additionally, asphalt capping of the LNAPL Area will better facilitate the LNAPL removal (due to its lack of mobility) and will prevent the LNAPL contamination from contributing further to the contaminant concentrations in ground water.

2.2 Site-Wide Ground-Water Conditions

Several ground-water stabilization/corrective measures have previously been implemented at the site including:

- Operation of the kerosene product/ground-water recovery systems in the LNAPL Area of the PDA;

- Implementation and operation of an interim ground-water extraction and treatment system in the Trichloroethene (TCE) Hot-Spot Area and southern end of the PDA; and

- Implementation and operation of an in-situ biosparging pilot system in the remaining ground-water Hot Spot area downgradient of the City of Nitro Dump.

The aforementioned activities were conducted in light of the following facts:

- Conditions at the site are stable and will not worsen over time;

- There are no significant risks to human health or the environment posed by current conditions;

- There is no local use of ground water or surface water for potable supply;

- There are no residential or industrial areas located downgradient from the site;

- There are no significant risks to human health or the environment posed by the site under realistic future use scenarios; and

- The Kanawha River is the sole discharge point for site ground water and represents the only receptor to be considered for protection of human health and the environment.

Prior to determining an appropriate ground-water remedy and preparing the CMS, comprehensive data evaluation and additional ground-water sampling activities are necessary.

The proposed data evaluation and additional ground-water sampling activities include:

- compiling existing soil and ground-water data, entering that data into a database (if warranted) and evaluating the existing data to identify data gaps and additional data needs;

- inspecting all existing wells to determine if well repairs or redevelopment are necessary;

- collecting and evaluating supplemental data to fill data gaps and provide additional data needed to more fully evaluate potential ground-water remedies; and

- conducting ground-water flow and fate and transport modeling, if warranted, to support the selection of potential ground-water remedies.

The ultimate objective of this work is to provide the information necessary to support the selection of an appropriate ground-water remedy to be included in the CMS.

3.0 CORRECTIVE MEASURES ALTERNATIVES

The overall goal of the corrective measures for ground water at this site is to eliminate any possible threat to human health and the environment that may be caused by the ground-water contamination that was previously described in the SCMER. While it is desirable to improve water quality to the extent practicable, a variety of factors influence the selection of a remedial plan for this site. These factors include:

- the properties and concentrations of the ground-water contaminants that exist at this site;
- the geology and hydraulics of the water-bearing formations at this site;
- the number and nature of receptors that exist downgradient from the site; and
- the technical practicability of available remedial technologies for ground-water.

Although a number of remedial technologies, including ground-water extraction and treatment, separate-phase product recovery and biosparging have been implemented previously as interim stabilization measures, this CMS Work Plan provides descriptions for a broad range of ground-water remedial options that will be considered as final corrective measures for this site. The remedial options for ground water at this site include:

- Natural Attenuation;
- Institutional Controls;
- In-Situ Ground-Water Remedial Technologies; and
- Ex-Situ Ground-Water Remedial Technologies.

Each of these options are described below. Further, any combination of natural attenuation, institutional controls and the ground-water remediation technologies may be applicable for use at this site. However, the purpose of this section is to identify and describe each remedial option planned for thorough evaluation in the forthcoming CMS.

3.1 Natural Attenuation

Natural attenuation is a passive remediation technique that relies on the dilution, dispersion, natural biodegradation, adsorption and volatilization of the contaminants in ground water. In order to properly evaluate natural attenuation as a remedial option for ground water, an evaluation of contaminant degradation rates and pathways as well as ground-water modeling will be needed. Also, with respect to modeling the ground-water contamination, downgradient receptors need to be evaluated and impact needs to be determined. Natural attenuation relies on the phenomena described above and relies on adequate ground-water monitoring over time until contamination reaches the appropriate ground-water quality criteria (GWQC). Finally, natural attenuation may also prove to be applicable if all active remedial technologies prove to be technically impractical.

3.2 Institutional Controls

Institutional controls are used to limit human activities at or near the contaminated site or to ensure the effectiveness of a remedial action over time. They may include structure, land and natural resource use restrictions, well restriction areas, deed notices and modified aquifer classification. Institutional controls are employed when contaminants remain at a site at levels above the applicable remediation standard that would allow for the unrestricted use of the property. As with natural attenuation, in order to implement institutional controls, modeling must be performed and the consequences of the institutional controls must be evaluated.

In accordance with the USEPA Office of Solid Waste and Emergency Response (OSWER) guidance concerning institutional controls, the following information will be evaluated to determine the feasibility of institutional controls at this site:

- A legal description of the real property and a clear identification of areas where institutional controls will be implemented;
- A description of the future uses for the areas;
- Identification of the residual hazard or risk present;
- Specific institutional control language proposed;
- Legal requirements of the applicable state and/or local jurisdiction;

- The responsible party for monitoring the integrity and effectiveness of the institutional controls and the frequency of monitoring required;

- Potential procedures used to report violations or failures of the institutional controls;

- Procedures that will be used to enforce against violations of the institutional controls; and

- Procedures necessary to provide notice of the institutional controls to subsequent owners or lessees.

The institutional controls proposed for evaluation in the CMS for this site include ground-water classification and deed notice. Additionally, the applicability of governmental controls such as municipal well use restriction ordinances will also be evaluated in the CMS.

3.2.1 Ground-Water Classification

In accordance with the USEPA "Guidelines for Ground-Water Classification" dated November 1986, "through the process of classification, ground-water resources are separated into hierarchical categories on the basis of their value to society, use and vulnerability to contamination." Furthermore, the guidance document also states that ground-water classification will be a factor in deciding the level of protection or remediation required for contaminated ground water. As part of the CMS, the proper ground-water classification for this site will be investigated in order to establish the appropriate GWQC. As a result of this exercise, the need for ground-water remediation and its extent will be defined.

The ground-water classification process for the site was initiated in early 2000 and was documented in the Response Report dated May 12, 2000. In the USEPA's response letter of August 16, 2000, the USEPA requested additional data that supports a classification of Class IIIA - Not a Source of Drinking Water. The additional data included a door-to-door survey and a verification of the subdivision of the Classification Review Area. If warranted after an initial review of existing information related to aquifer classification, the additional data will be assessed for inclusion in the CMS.

3.2.2 Deed Notice

Although future planned use for this site remains industrial, the need to establish a deed restriction/notice will be evaluated as part of the CMS. A deed restriction/notice, also known as a declaration of environmental restriction (DER), legally modifies the property deed in order to restrict ground-water usage at the property. The establishment of a deed restriction/notice will eliminate the contaminant exposure pathway related to future ground-water use at this site.

3.3 In-Situ Ground-Water Remedial Technologies

In-situ remediation of ground water involves the reduction of contaminant concentrations in ground water without removing the ground water from its respective aquifer. The advantages of in-situ ground-water remediation typically include less engineering design effort, less energy required as a result of not pumping ground water, and the elimination of discharge requirements. As described below, a variety of in-situ ground-water remedial technologies including accelerated natural attenuation through bioremediation, air sparging, and sheet piling containment are proposed for CMS evaluation. Although sheet piling containment is not an in-situ ground-water remediation technology per se, it is described in this section for its establishment as an in-situ enhancement to be utilized for hydraulic containment and control in conjunction with other remedial technologies.

3.3.1 Accelerated Natural Attenuation

Accelerated natural attenuation consists of augmenting the natural geochemistry of the area to be remediated in order to make the area more conducive to natural attenuation. This is typically referred to as bioremediation because it usually involves the addition or nourishment of micro-organisms (fungi, bacteria and other microbes) that naturally degrade contaminants under favorable circumstances. The augmentation of the natural geochemistry consists of the supplemental addition of nutrients, electron acceptors and, if necessary, inoculated micro-organisms that, due to lacking quantities, may be limiting the rapid conversion of contaminants into innocuous end products. The accelerated natural attenuation methods proposed for CMS evaluation and described below include Hydrogen Release Compound (HRC™) injection, Oxygen Release Compound (ORC™) injection and biosparging with oxygen.

Another accelerated natural attenuation technology that was considered for CMS evaluation but not included herein is cometabolism. Cometabolism involves the injection of a secondary cometabolic substrate into the contaminated ground water to produce enzymes for primary substrate oxidation and degradation. Although methane addition supports the methanotrophic (bacterial) activity required to degrade TCE, cometabolism is not proposed as a CMS evaluation technology because the heterogeneous subsurface conditions at this site would make substrate circulation difficult. As a result of difficulties involved with the subsurface circulation of methane, health and safety concerns with respect to combustion could pose a serious threat.

3.3.1.1 Hydrogen Release Compound (HRC™) Injection

Anaerobic bioremediation is one of the primary natural attenuation mechanisms for containing and remediating select metals, pesticides and chlorinated solvents such as TCE. As such, HRC™ has been proven as a viable supplement to accelerate anaerobic degradation of select compounds. HRC™ is a proprietary polyacetate ester that is specially formulated for the slow release of lactic acid upon hydration. The lactic acid is metabolized by the natural anaerobic microbes contained within the saturated subsurface and as a result of the anaerobic conditions, hydrogen is produced. The hydrogen is used as an electron donor for the dechlorination of TCE. As a result, TCE is degraded as it would be through natural attenuation but in an accelerated manner.

HRC™ appears to be a potential corrective measure for remediating TCE contamination in the TCE Hot Spot Area. HRC™ is a moderately flowable material that can be placed directly in wells or injected into the saturated zone using direct push (Geoprobe®) techniques. As part of the CMS, the amount of HRC™ required will be determined based upon the total mass of contaminant that exists in ground water. From this mass balance calculation, the number and spacing of HRC™ injection points required will be determined. Also, a list of anaerobic bioremediation indicator parameters for ground-water analysis will be developed for determining the applicability of HRC™ injection. Select wells will be sampled for the parameters on this list (prior to submitting the CMS) as part of the ground-water sampling proposed in Section 4.2.3 of this CMS Work Plan.

3.3.1.2 Oxygen Release Compound (ORC™) Injection

Aerobic degradation is a critical contributor to the natural attenuation of petroleum hydrocarbons and select chlorinated hydrocarbons such as dichloroethene (DCE) and vinyl chloride (VC). As such, ORC™ has been proven as a viable supplement to accelerate the natural attenuation of these compounds. ORC™ is a proprietary formulation of magnesium peroxide in a powder form that, upon hydration, provides for the timed release of oxygen into the saturated subsurface. With the presence of oxygen, the natural aerobic heterotrophs (bacteria) readily feed on the carbon sources provided by the hydrocarbons and the hydrocarbons are converted into harmless by-products such as carbon dioxide and water.

ORC™ appears to be a potential corrective measure for remediating TCE daughter products (DCE and VC) in the TCE Hot-Spot Area, dissolved-phase hydrocarbon contamination in the LNAPL Area and dissolved-phase benzene and phenols in the City of Nitro Dump Area. ORC™ can be applied as a powder in excavations, as a powder contained in permeable "socks" in wells or as a slurry (powder and water mixture) through direct push injection (Geoprobe®). As part of the CMS, the amount of ORC™ required will be determined based upon the total mass of contaminant that exists in ground water. From this mass balance calculation, the number and spacing of ORC™ injection points required will be determined. Also, a list of aerobic bioremediation indicator parameters for ground-water analysis will be developed for determining the applicability of ORC™ injection. Select wells will be sampled for the parameters on this list (prior to submitting the CMS) as part of the ground-water sampling proposed in Section 4.2.3 of this CMS Work Plan.

3.3.1.3 Biosparging

As stated in the SCMER dated January 25, 1999, bench-scale and pilot tests have been completed proximate to monitoring well WT-14A (in the City of Nitro Dump Area) utilizing biosparging for the remediation of benzene, methyl-phenols and chloro-phenols in ground water. As with the injection of ORC™ described above, the injection of gaseous oxygen into the contaminated ground water stimulates the natural heterotrophs that readily feed on the carbon sources provided by the benzene and phenolic compounds. The results of the bench-scale and pilot tests concluded that by introducing gaseous oxygen into the saturated zone, dissolved oxygen levels as well as the aerobic degradation of the benzene and phenolic compounds in ground water increased. Therefore, the CMS will contain an evaluation of the biosparge bench-scale and pilot tests to determine if a full-scale system is warranted in the City of Nitro Dump Area as well as in the LNAPL Area.

3.3.2 Air Sparging

Air sparging is an in-situ remediation technology for volatile organic compounds (VOCs) and fuels in ground water in which air is injected into the saturated zone of contamination. The injected air moves up through the ground water both vertically and horizontally in channels through the soil column. As it moves up through the ground water, mass transfer phenomena occur and the air "strips" the contaminant mass from the ground water through volatilization. The air is injected at a depth sufficiently below the static water table elevation and through points that are strategically spaced to have a profound effect upon the dissolved contaminant plume. As a result of the transfer of contaminant mass from ground water to air, air sparging is usually coupled with soil vapor extraction (SVE) to capture the vapor-phase contaminants. The CMS will contain an evaluation of air sparging for all of the ground-water AOCs based upon the properties of the contaminants present, the geologic setting and the cost effectiveness of utilizing an air sparge system. As a result of the vapor-phase contamination created by air sparging, SVE with the appropriate emissions control technology (catalytic oxidation or vapor-phase carbon) will also be factored into the CMS evaluation of this technology. The air sparging evaluation will include a series of mass balance projections and, if deemed necessary, an air sparge/SVE pilot test.

3.3.3 Sheet Piling Containment

Sheet piling containment involves driving sheet piling in the flow path of the ground-water contamination to the depth of a confining layer. In doing so, the sheet piling acts as a barrier to inhibit the contaminated ground water from migrating beyond the limits of the barrier. However, because this type of containment only inhibits the ground-water contamination from migrating and does not result in treatment of the contamination, this technology requires teaming with some form of ground-water extraction and treatment.

One technology that would possibly be used in conjunction with sheet piling containment would involve the use of a funnel and gate with an in-situ permeable reactive wall. The depth to the siltstone bedrock interface (confining layer) would define the depth of an in-situ permeable reactive wall as approximately 55 feet. Because this is not an achievable excavation depth using conventional excavation techniques at this site, an in-situ permeable reactive wall is not proposed for further evaluation in the CMS. However, sheet piling containment in a funnel and gate system with ground-water extraction and treatment will be evaluated as part of the CMS and is discussed in the Ex-Situ Ground-Water Remedial Technologies section of this report (Section 3.4).

3.4 Ex-Situ Ground-Water Remedial Technologies

Ex-Situ ground-water remedial technologies involve the pumping of ground water to an aboveground water treatment system for acceptable discharge to ground water, surface water, process operations, a waste disposal/treatment facility or a publicly-owned treatment works (POTW). In this section, various methods of extracting and treating contaminated ground water are discussed.

3.4.1 Ground-Water and Separate-Phase Product Extraction Technologies

The methods for extracting ground water include ground-water extraction wells spaced out over the entire horizontal width of the ground-water contaminant plume and a funnel and gate system with less ground-water extraction points in a concentrated ground-water extraction area. With respect to separate-phase product removal, three (3) techniques have been previously attempted and one (1) additional technique will be considered in the CMS. The four (4) product removal techniques presented in this section and their status with respect to the CMS are:

- Total fluids extraction which has been attempted with limited success in the LNAPL Area;

- Dual-Phase extraction which has been attempted with very limited success in the LNAPL Area;

- Separate-Phase extraction which has been attempted with very limited success in the LNAPL Area; and

- Vacuum extraction, which will be evaluated for the first time in the CMS.

The evaluation of these four (4) product extraction techniques is limited to areas that contain separate-phase product.

A dual-phase extraction system involving a ground-water depression pump and a product skimmer pump, as well as a separate-phase extraction system involving a product-only pump were tested previously at the site and had very limited success in removing separate-phase product. Dual-phase extraction will not be evaluated in the CMS because total fluids extraction appears to be more successful in its performance. However, although the separate-phase extraction technique utilizing product-only pumps experienced only limited success, periodic hand bailing appears to be a possible alternative for separate-phase product extraction and will be evaluated as discussed in the separate-phase extraction section below (Section 3.4.1.4).

As stated above, the ground-water extraction technologies discussed herein must be coupled with the treatment and discharge options described in Sections 3.4.2 and 3.4.3, respectively. Each ground-water extraction technology will be evaluated on the basis of providing hydraulic control as well as contaminant mass removal. Separate-phase product extraction technologies will be evaluated based upon their ability to reduce the amount of product present and, in some cases, their benefit with regard to dissolved-phase contaminant removal.

3.4.1.1 Ground-Water Extraction Wells

Ground-water extraction wells are already being utilized as an interim corrective measure to reduce TCE mass in the TCE Hot Spot Area. Basically, ground-water extraction wells are installed proximate to ground-water contaminant plumes in order to provide hydraulic control in the areas of these plumes and to remove contaminant mass through total fluids extraction. Through the additional ground-water sampling proposed in Section 4.2.3 of this report, the effectiveness of the extraction wells in the TCE Hot Spot Area will be evaluated. Based upon the results of the TCE Hot Spot evaluation, total fluids extraction wells may also be evaluated to provide dissolved-phase contaminant mass removal and hydraulic control in the other two (2) AOCs.

3.4.1.2 Funnel and Gate with Ground-Water Extraction

As stated above, a funnel and gate system consists of driving sheet piling in the flow path of the contaminated ground water (funnel) in order to direct all contaminated ground water through one (1) relatively narrow downgradient opening (gate). The contaminated ground water is then extracted from the gate using extraction wells or other collection methods for treatment. Depending upon the rate of ground-water flow across the site and the areal extent of the contaminant plumes, this technology will be evaluated in the CMS to limit the number of extraction points needed to ensure capture of the dissolved-phase contaminants. This technology will also be evaluated based upon its ability to dilute the contamination for easier treatment.

3.4.1.3 Total Fluids Extraction

Total fluids extraction involves the removal of ground-water with a drawdown rate that is also conducive to product removal. This type of extraction is intended to remove the separate-phase product as well as the dissolved-phase contamination simultaneously. As per the SCMER, the success of total fluids extraction in the LNAPL Area was very limited for the same reasons that separate-phase and dual-phase extraction technologies were limited in their success. However, this may have been due partially to the intermittent operation of the interim corrective measures system that was installed for total fluids extraction in the LNAPL Area. Therefore, prior to completing the CMS, the total fluids removal system in the LNAPL Area will be operated with a maximum operational time and effort over a two (2) month period. With the data collected during this operational time, total fluids extraction will be evaluated for its benefit in removing product as well as dissolved-phase contamination.

3.4.1.4 Separate-Phase Extraction

Separate-Phase extraction involves the collection of LNAPL through the continuous operation of product skimmers (pumps or bands) or through periodic hand bailing of product. As stated above, separate-phase extraction was attempted through the use of product-only pumps with very limited success. Therefore, hand bailing of separate-phase product will be evaluated as a possible corrective measure for the LNAPL Area. In order to properly consider this option in the CMS, previously conducted bail down tests will be reviewed and, if deemed necessary, additional product bail down tests will be conducted to determine the achievable rate of product recovery and the product recharge rates within the LNAPL Area wells. The frequency of bailing and the wells utilized for the bail down tests will be determined by observed product recharge rates and the amount of product in each well. Additionally, data associated with LNAPL thickness and recharge will be used in a BIOSLURP® areal finite element model to optimize LNAPL recovery in the future. Finally, because this technology does not address dissolved-phase contamination, hand bailing will be evaluated in conjunction with a ground-water extraction technology in the CMS as a total corrective measure for the LNAPL Area.

3.4.1.5 Vacuum Extraction

Vacuum extraction consists of fitting each well that contains free product with a well head and adjustable down-hole suction tube for connection to a vacuum truck or vacuum pump. The suction tube is strategically placed just above the depth to product in an attempt to remove the separate-phase product with minimal ground-water removal. This technology will be evaluated prior to preparing the CMS on LNAPL Area wells that contain separate-phase product. The evaluation will consist of mobilizing a vacuum truck on three (3) separate occasions at intervals determined through product recharge within the wells, to vacuum product out of each well. The product and ground water extracted through this testing will be disposed off-site or will be passed through the existing oil/water separator system at this site. If the on-site system is utilized then ground water will be treated at the on-site wastewater treatment plant (WWTP). As with separate-phase extraction, BIOSLURP® will be used to evaluate and optimize the potential vacuum extraction of LNAPL at this site. Based upon the testing described herein, the frequency for vacuum extraction will be determined and the benefits of using a vacuum truck versus the use of a permanent on-site vacuum system (using a high vacuum blower) will be evaluated.

3.4.2 Ex-Situ Ground-Water Treatment Technologies

As stated above, the contaminated ground-water extraction technologies proposed for CMS evaluation must be coupled with ex-situ treatment technologies in order to allow for the appropriate discharge of the water. This section evaluates the most feasible treatment technologies based upon the ground-water contaminants of concern. In the CMS evaluation these treatment technologies will be further evaluated based upon projections involving operating conditions, overall treatment period and overall treatment costs.

The ex-situ ground-water treatment technologies proposed for evaluation in the CMS include:

- Separation;
- Carbon Adsorption;
- Air Stripping; and
- Ultraviolet Oxidation (UV/OX).

Descriptions of these treatment technologies as well as the means for evaluating each technology are provided below.

In addition to the ground-water treatment technologies described below, bioreactors such as trickling filters, sequencing batch reactors, rotating biological contractors, activated sludge systems and fluidized bed reactors were also considered for CMS evaluation. However, bioreactors were eliminated because the related operational demands, size and cost requirements (capital and operation) are much higher than those related to the treatment technologies evaluated below, and the treatment technologies evaluated below should provide an adequate base for the final treatment technology selected in the CMS.

3.4.2.1 Separation

Separation processes involve the detachment of contaminants from the medium that binds them (soil, ground water, etc.). The separation of contaminants from ground water can be performed using a wide variety of processes including distillation, filtration, reverse osmosis, membrane pervaporation and physical separation. All of these separation processes result in a concentrated contaminant end product that requires disposal unless it can be re-used in a process. Because all of these separation processes except physical separation are costly and typically require other processes to completely remediate contaminated ground water, the only separation process proposed for CMS evaluation is physical separation.

Because physical separation through the use of an oil/water separator has been implemented as part of an interim corrective measure in the LNAPL Area, it will be evaluated in the CMS as part of a remedial alternative for the separate-phase product. An oil/water separator utilizes the density difference between oil and water along with gravity to separate the oil from the water.

The oil is stored in a container for subsequent disposal while the water is usually sent through another treatment process to remove the dissolved-phase contamination. In the CMS, the use of an oil/water separator will be evaluated in conjunction with the total fluids extraction technique described above. The evaluation will be based on previous LNAPL removal and water flow rates to determine if separation is a cost effective alternative.

3.4.2.2 Carbon Adsorption

Liquid-phase carbon adsorption consists of pumping water through one or more vessels containing granular activated carbon (GAC). Usually, at least two (2) GAC vessels are used in series to avoid breakthrough of contaminants to the ultimate point of discharge. As the contaminated water passes through the GAC, the contaminants are adsorbed by the carbon and the water is discharged without the contaminants. As the available pore spaces of the GAC become saturated with contaminant, the effectiveness of the GAC begins to diminish and replacement or regeneration of the GAC is required. Also, pretreatment filtration is required whenever there is a chance that the GAC may become clogged due to high solids content or precipitated metals in the treated water. Because carbon adsorption has been proven successful for the removal of hydrocarbons and semi-volatile organic compounds (SVOCs), it will be evaluated as a potential primary treatment of hydrocarbons in ground water. Carbon adsorption may also be evaluated for post treatment polishing involving the removal of chlorinated VOCs and SVOCs from ground water. The evaluation will consist of projected carbon usage calculations, mass removal calculations and associated cost analyses.

3.4.2.3 Air Stripping

Air stripping involves the partitioning of VOCs from water by increasing the surface area of the contaminated water that is exposed to a counter-current airflow. Air stripping is completed based upon mass transfer theory and a compound's ability to be stripped is a function of its Henry's Constant (H). Compounds with relatively higher Hs are more susceptible to air stripping. Because the Hs for TCE and most petroleum hydrocarbons are relatively high, all of the COCs at this site except for the phenols in the City of Nitro Dump Area are amenable to air stripping. As a result, air stripping will be evaluated in the CMS as a viable ex-situ ground-water treatment option. Air stripping will be evaluated by modeling the rate of contaminant mass removal that can be achieved and by applying the mass removal rate to cost analyses. As air stripping has a tendency to aerate and precipitate dissolved solids and metals, the air stripping evaluation will also include a review of total dissolved solids and metals analysis associated with ground water.

3.4.2.4 Ultraviolet Oxidation (UV/OX)

UV/OX is a destruction process that oxidizes organic contaminants in wastewater through the addition of strong oxidizing agents and irradiation with UV light. The oxidation of the contaminants is caused by their direct reaction with the oxidizing agents, UV photolysis and through the synergistic action of UV light in combination with ozone or hydrogen peroxide. Typically, due to the hydroxyl radicals produced in using UV/OX with hydrogen peroxide, any organic compound can be reduced to carbon dioxide and water. However, in order to achieve the required system destruction efficiency, the proper Electrical Energy consumption per Order of magnitude reduction in contaminant concentration (EE/O) per 1,000 gallons of water and the proper hydrogen peroxide feed rate must be determined. In order to determine these design factors, the presence of UV interference compounds, hydroxyl scavengers and precipitates must be evaluated. During the supplemental ground-water sampling proposed in Section 4.2.3 of this report, the presence of UV interference compounds, hydroxyl scavengers and precipitates will be determined in each AOC. From this information, the size of the UV/OX system for each AOC as well as the EE/O and hydrogen peroxide usage can be calculated to evaluate projected UV/OX efficiency and cost. As part of this evaluation, the need for ozone addition and off-gas treatment will also be determined. Through these evaluations, the feasibility of UV/OX will be determined for each AOC.

3.4.3 Discharge/Disposal Options

If ex-situ treatment of contaminated ground water is identified as a retained corrective measure for any of the AOCs, options with respect to treated water and separate-phase product discharge/disposal will be considered in the CMS. Most likely, the only option for collected separate-phase product will involve off-site disposal/treatment. However, treated ground water can be discharged in a variety of ways. The discharge options proposed for CMS evaluation include:

- discharge to surface water;

- discharge to ground water;
- discharge to the on-site WWTP (which is the current point of discharge for the TCE Hot Spot extraction wells and LNAPL Area water);
- discharge to the local publicly owned treatment works (POTW) through the sanitary sewer; and
- plant re-use.

All of these discharge options will be evaluated in the CMS based upon their required permitting, required treatment limits, flow restrictions, liability issues and costs.

4.0 APPROACH TO CMS EVALUATION

4.1 Past Disposal Area

The approach to CMS evaluation of the PDA will involve the elimination of the PDA's ability to contribute to ground-water contamination.

4.1.1 Background

The PDA SWMU occupied a portion of a triangular piece of land covering approximately 5.7 acres in the northern part of the Process Study Area adjacent to the Kanawha River. The unit historically was used for on-site disposal. The unit currently contains the site of the former Tepee Incinerator, the Niran Residue Pits and the Aboveground Equalization/Storm-Water Surge Tanks, which are also designated as additional SWMUs.

Currently, the area is an open gravel-covered area, with part of the area being used for storage of machinery and assorted parts. Surface-water runoff is directed to a drainage swale on the eastern edge of the unit. A water-filled depression is located in the central part of the PDA. The depression is associated with the concrete foundation of a former structure.

The PDA SWMU was originally closed in 1985 as part of a Consent Agreement with USEPA Region III (III-85-17-DC). Stabilization measures to close this SWMU have included regrading and capping of the area with gravel.

The Tepee Incinerator was located near the Kanawha River within the boundaries of the PDA. The unit was operated between 1958 to 1962 to burn plant trash and rubbish. Waste materials containing hazardous constituents are not known to have been burned in the incinerator. Following the cessation of operation in 1962, the Tepee Incinerator was decommissioned and removed. The former area where the incinerator was located has been regraded and remains as open unused space. The area is currently gravel-covered.

The Niran Residue Pits SWMU was located within the boundaries of the PDA. No facility records were maintained as to the nature and quantities of hazardous materials disposed in this area. Niran was formerly used as a broad spectrum insecticide consisting of 2,4,5-

trichlorophenol and other related compounds. The area surrounding the former Niran Residue Pits has been covered and regraded to manage surface water flow as part of the PDA stabilization measures. This area is currently gravel-covered.

The Aboveground Equalization/Storm-Water Surge Tanks SWMU was constructed in 1990, and consists of four equally-sized, 82-foot diameter steel tanks with a combined storage capacity of 4.8 million gallons. This SWMU is located within the PDA. The tanks are used for storage of nonhazardous wastewater, and provide a means to equalize flow prior to discharge to the facility's WWTP. This SWMU has never received hazardous waste. The regrading and gravel cover performed in 1985 as part of the former stabilization of the PDA also regraded and covered the area of the current Aboveground Equalization/Storm-Water Surge Tanks. The tanks were constructed subsequent to stabilization of the area and received only nonhazardous wastewater. Each tank is equipped with leak detection measures and is situated atop a concrete slab foundation with a synthetic liner installed beneath the tank.

4.1.2 Proposed Asphalt Cap

Apparently, the only area of the PDA that may be contributing contamination to ground water is the LNAPL Area. As such, an asphalt cap is proposed for the LNAPL Area. The cap will provide a barrier against disturbance of impacted soil underlying the area, by human or animal vectors. Also, the cap will provide a barrier against vertical percolation of precipitation (rain and snow), and will prevent the LNAPL from mobilizing or contributing dissolved-phase contaminants to ground water in the area. The proposed cap will be constructed over the area shown on Plate 1.

Cap construction will consist of the placement of a 6-inch layer of compacted subbase material followed by the placement of a bituminous asphalt layer. The bituminous asphalt layer will consist of a 4-inch thick stabilized bituminous base course overlain by a 2-inch thick bituminous concrete surface course.

Upon the approval of the CMS Work Plan by the USEPA, Solutia Inc. will prepare an Interim Stabilization Measures (ISM) Plan for the proposed asphalt cap. The ISM Plan will include the design drawings and specifications for the construction of the asphalt cap. Upon the implementation of the ISM, Solutia Inc. will submit an ISM Report summarizing the implementation activities.

4.2 Site-Wide Ground Water

Except for the PDA soils, the only AOCs to be addressed in this CMS Work Plan are related to groundwater. The SCMER dated January 25, 1999 identified the following ground-water AOCs:

- TCE in the Process Study Area (the TCE Hot-Spot Area);
- Benzene, TCE, and separate-phase kerosene (the LNAPL Area) in the PDA (which is also part of the Process Study Area) ; and
- SVOCs, namely phenolic compounds, in the Nitro Dump Area (which is part of the Waste Treatment Study Area).

Site investigation activities, including ground-water sampling, have been conducted at the site beginning in the early 1980s. To date, only limited ground-water sampling has been conducted in each of the three ground-water AOCs identified above, with the exception of the periodic sampling of select wells in the TCE Hot Spot and LNAPL areas. In addition, the data have generally been evaluated as phases of work were completed and have not yet been evaluated in a site-wide, comprehensive manner. Therefore, prior to determining an appropriate ground-water remedy through the preparation of the CMS, comprehensive data evaluation and additional ground-water sampling activities are necessary. The ultimate objective of this work is to provide the information necessary to support the selection of an appropriate ground-water remedy to be included in the CMS.

The proposed data evaluation and additional ground-water sampling activities include:

- compiling existing soil and ground-water data into a database (if warranted) in order to more efficiently evaluate site conditions and to identify data gaps and additional data needs;
- inspecting all existing wells to determine if well repairs or redevelopment are necessary;

- collecting and evaluating the supplemental data to fill data gaps and provide additional data needed to more fully evaluate potential ground-water remedies; and

- conducting ground-water flow and fate and transport modeling, if warranted, to support the selection of potential ground-water remedies.

The scope of work associated with each of these tasks is presented below.

4.2.1 Evaluation of Existing Data

This task will consist of compiling and evaluating existing site investigation data. The existing data will be entered into a spreadsheet or a database (such as EQuIS®), based on the extensiveness of the existing data. Entering the existing data into a database will facilitate the comparison and evaluation of existing data with data to be collected in the future.

Following compilation and entry into the database, the existing data will be evaluated to identify potential data gaps (both in sample/well locations and analytical parameters) and refine recommendations for additional sampling and analyses presented in Section 4.2.3 below. This task may also include contacting the laboratory used to analyze samples collected as part of the current sampling conducted in the TCE Hot Spot and LNAPL areas, and requesting they provide results for all VOCs of concern and their related daughter products. This request would only be made for select, recent (non-archived) sampling events.

Following completion of the evaluation of the existing data described above, a report will be prepared and submitted to the USEPA describing the findings of the data evaluation. This report will also include a detailed work plan for the collection and evaluation of supplemental data. Solutia Inc. will implement the supplemental sampling work plan upon the USEPA's approval. The objectives and generalized supplemental work plan is discussed in Section 4.2.3 below.

4.2.2 Well Inspection, Repairs and Redevelopment

Based on the evaluation of the existing data, ground-water sampling of certain existing wells will likely be recommended to fill data gaps and provide additional data related to ground-water flow, ground-water treatment effectiveness and natural biodegradation. However, many of the existing wells have not been sampled or otherwise used since the mid 1980s. Therefore, prior to sampling, existing wells will be inspected and repaired and/or redeveloped as needed.

The well inspection will consist of visually inspecting the condition of the protective casing, the inner well casing and the concrete pad. The depth to the bottom of each well will also be measured and compared to the reported installation depth. This information will be used to estimate the amount of sediment buildup in the well, if any.

In the event that a well is found to be damaged beyond reasonable repair and/or cannot be successfully redeveloped, the well will be properly abandoned. Well replacement will only be conducted if a suitable existing well cannot be sampled in place of the damaged well. Based on the number and location of existing wells and the objectives of the supplemental data collection activities, replacement of damaged wells requiring abandonment, if any, is not anticipated to be necessary.

Based on the findings of the well inspection, appropriate repairs and/or redevelopment will be proposed in the supplemental work plan described in Section 4.2.1. Repairs may consist of replacing the concrete pad, protective casing, inner well caps, locks, etc. Well redevelopment will be proposed if significant sediment buildup in the bottom of the well is discovered. The potential need for redevelopment will be determined following review of the inspection findings, but will generally be recommended if at least three inches of sediment are measured in the well and the well is recommended for sampling as part of the supplemental data collection. Well redevelopment, if needed, will be accomplished by overpumping with a surface or submersible centrifugal pump. Well redevelopment activities will consist of removing accumulated sediments from the bottom of the well and will continue until such time that water runs visibly clear or for a maximum of one hour per well. Development water will be containerized and discharged to the on-site WWTP (either directly or via the sewer system). The well repair and redevelopment portions of this task will only be conducted following completion of the data evaluation and USEPA's review of the supplemental work plan described in Section 4.2.1.

4.2.3 Collection of Supplemental Data

This task will include the collection of supplemental data necessary to fill potential data gaps identified during the initial data evaluation described above and to acquire additional data that may be necessary to identify potential appropriate ground-water corrective measures. As stated above, a detailed supplemental sampling work plan will be submitted for USEPA review and approval following completion of the initial data evaluation. Potential activities that may be included in the supplemental sampling work plan include:

- Sampling of select existing wells to fill the data gaps (spatially across the site or in areas where recent sample results are not available);

- Collection of ground-water grab samples using direct-push methodology (this sampling will be conducted in the main plant area to fill the data gap between existing upgradient and downgradient wells);

- Completion of two semi-annual ground-water sampling events in select existing wells to obtain current, site-wide ground-water quality data (these results will also be used in conjunction with existing historical data to determine ground-water concentration trends);

- Analyzing ground-water samples for contaminants of concern (COCs), treatability parameters and natural attenuation indicator parameters specific to the AOC in which the samples are collected (for the VOC portion of the analyses, all VOCs of concern at the site plus their daughter products would be reported while the natural attenuation indicator parameters may include constituents such as chloride, nitrate, sulfate, sulfide, dissolved and total iron, dissolved and total manganese, carbon dioxide, methane, ethene, ethane, and field parameters [dissolved oxygen, ORP, pH, temperature]); and

- Entering all new data into the database to be constructed.

Following completion of the supplemental ground-water sampling activities, the supplemental data will be evaluated in conjunction with the existing historical data. This evaluation will be used to determine the distribution of COCs in site ground water, to determine treatment options and to determine whether existing conditions are amenable to natural degradation of COCs. Existing and supplemental data will be evaluated using a variety of methods depending on the data available and results. Several key methods of data evaluation that may be used include:

- result tables summarizing historical results and identifying which constituents exceed remediation goals;
- isoconcentration contour maps to determine the spatial distribution of COCs;
- concentration versus time trend graphs;
- concentration versus distance data along the approximate plume centerline; and
- evaluating changes in concentration versus distance/location for natural attenuation indicator parameters.

4.2.4 Ground-Water Flow and Fate and Transport Modeling

Depending upon the findings of the initial data evaluation and the supplemental ground-water sample data results, ground-water flow and/or fate and transport modeling may be warranted. If conducted, the objectives of the modeling would be to:

- simulate flow patterns and capture zones;
- estimate mass loading to the Kanawha River;
- support the proposed remedy to be presented in the CMS;
- assist in determining long-term monitoring requirements; and
- provide an initial estimate of anticipated cleanup times and costs.

Ground-water flow and fate and transport modeling may use simple, one or two-dimensional models such as Bioscreen (USEPA, August 1996), Biochlor (USEPA, March 1999) or Flowpath II (Waterloo Hydrogeologic, 1997) or more complex, three-dimensional flow and transport models such as Modflow (MacDonald and Harbaugh, 1988) and MT3D^{99} (S.S. Papadopulos and Associates, 1999). The need for and type of modeling conducted will be based on the findings of the initial data evaluation and the supplemental data collection and evaluation.

If modeling is conducted and used to substantially support the selected remedy presented in the CMS, an initial modeling report will be prepared and submitted to the USEPA for review and approval prior to preparing and submitting the CMS. Preparation and submission of a modeling report prior to submission of the CMS is recommended to avoid substantial comments and revisions to the CMS should the USEPA dispute the modeling results. In the event that a simple model is used or the modeling is only used as a minor supporting element of the selected ground-water remedy to be presented in the CMS, then the modeling procedures and findings will be included in the CMS report and a separate modeling report will not be submitted.

4.2.5 Monitored Natural Attenuation

At this time, monitored natural attenuation (MNA) is believed to be a potentially viable ground-water remedy. Therefore, if supported by the existing and supplemental data, a MNA Work Plan for ground water will be prepared and included as part of the CMS report. The MNA Work Plan presented in the CMS would include elements such as wells to be sampled, sampling frequency, analytical parameters, proposed natural attenuation indicator analytical parameters, sampling procedures and a QA/QC plan. The MNA Work Plan may also incorporate varying approaches to sampling frequency, wells to be sampled, and analytical parameters. For example, sampling on a quarterly basis may be recommended for the first two years, then reduced to semi-annual and then annual sampling for subsequent years. Similarly, analytical parameters may include a "complete" list of parameters to be analyzed on an annual basis and a reduced list of parameters for quarterly sampling events. A provision to allow for a modification to the sampling plan would also be included in the CMS.

The MNA Work Plan will also describe proposed method(s) to be used to evaluate the effectiveness of natural attenuation and to estimate the timeframe in which the remedial objectives for COCs will be achieved. At this time, our anticipated primary method of data evaluation is graphical trend and projection analysis. This evaluation will be conducted for both concentration versus time data and concentration versus distance data along the approximate plume centerline. These straightforward trend analyses are based on site data and do not rely on fate and transport modeling. If modeling is conducted as outlined in Section 4.2.4 above, the MNA results could also be used to verify and recalibrate the model, if necessary.

5.0 OUTLINE OF CMS REPORT

Source 4

Executive Summary

This section will summarize the findings of the CMS. In particular, the Executive Summary will briefly highlight the Corrective Measures Alternatives and the Preferred Remedial Alternative.

5.1 Introduction/Purpose

This section will describe the purpose of the document and provide a summary description of the project.

5.2 Description of Current Conditions

This section will include a brief summary/discussion of any new information that has been discovered since the RFI Report was finalized. The discussion will concentrate on the issues that could significantly affect the evaluation and selection of the corrective measures alternative(s).

5.3 Cleanup Standards

This section will present cleanup standards that are based on promulgated Federal and State standards, data and information gathered during the corrective measures process, and/or other applicable guidance documents.

5.4 Identification, Screening, and Development of Corrective Measures Alternatives

This section will expand the discussion provided in Section 3.0 of this CMS Work Plan (i.e., Corrective Measures Alternatives). The section will focus on potentially applicable technologies that may be used to achieve the corrective action objectives.

5.5 Evaluation of Corrective Measures Alternatives

For each remedy that warrants a more detailed evaluation, this section will provide documentation of how the potential remedy will comply with each of the standards listed below.

5.5.1 Protection of Human Health and the Environment

This section will discuss how the proposed corrective measures alternative is protective of human health and the environment.

5.5.2 Attainment of Media Cleanup Standards

This section will address whether or not the proposed remedy will result in the attainment of the media cleanup standards. Also, the section will discuss whether the potential remedy will achieve the overall remediation objectives.

5.5.3 Compliance with Applicable Standards for the Management of Wastes

This section will include a discussion of how the specific waste management activities will be conducted in compliance with applicable State or Federal regulations.

5.5.4 Other Factors

5.5.4.1 Long-Term Reliability and Effectiveness

This section will discuss whether the proposed technologies have been used effectively under analogous site condition, whether their failure will have an immediate impact on receptors, and whether the alternatives will have the flexibility to deal with uncontrollable changes at the site (e.g., heavy rains).

5.5.4.2 Reduction in the Toxicity, Mobility or Volume of Wastes

This section will address how much the corrective measures will reduce the waste toxicity, volume, and/or mobility.

5.5.4.3 Short-Term Effectiveness

This section will discuss the short-term effectiveness of the proposed technology against potential threats associated with treatment, transportation, or containment of waste material.

5.5.4.4 Implementability

This section will assess:

- The administrative activities needed to implement the corrective measures alternatives (e.g., permits), and the length of time these activities will require;

- The constructibility, time of implementation, and time required to recognize the beneficial results; and

- The availability of adequate off-site treatment, storage capacity, needed technical services and materials.

5.5.4.5 Cost

The cost estimate for each alternative will include costs for: engineering, construction, materials, labor, sampling/analysis, waste management, permitting, operation and maintenance, etc.

5.6 Preferred Remedial Alternative

This section will discuss the preferred remedial alternative including a description and supporting rationale. The description will include preliminary design criteria.

5.7 Public Involvement Plan

This section will discuss the need for public meetings which may be warranted as a result of the CMS.

6.0 PROJECT TEAM

Solutia Inc. has retained Roux Associates, Inc. to manage the CMS. Roux Associates, Inc. will assemble a team of qualified environmental scientists and engineers to evaluate the corrective measures alternatives. The project will be managed from Roux Associates, Inc.'s West Deptford, New Jersey office. Field support will be provided by Potesta and Associates in Charleston, West Virginia. Laboratory analytical services will be provide by Research Environmental and Industrial Consultants, Inc in Beaver, West Virginia. Soil borings and well installation services, if warranted, will be provided by GeoEnvironmental Drilling or Enviroprobe. Key members of the proposed project team are described below. Professional profiles are provided in Appendix B.

Mr. Camille Costa, P.E., Principal Engineer at Roux Associates, Inc., will serve as Project Manager. Mr. Costa has 15 years of experience in hazardous waste remediation and regulatory compliance. He has managed numerous environmental investigations for CERCLA and RCRA hazardous waste sites. He has developed and implemented Feasibility Study (FS) and CMS reports for industrial facilities.

Mr. John Loper, P.E., Vice President and Principal Engineer at Roux Associates, Inc., will serve as Quality Assurance Manager. In this capacity, Mr. Loper will provide technical oversight and review of project activities. Mr. Loper will provide quality assurance/quality control review of project deliverables. Mr. Loper has over 25 of years experience in environmental investigations, site remediations, and agency negotiations.

Mr. Thomas J. Patterson, E.I.T., Senior Engineer at Roux Associates, Inc., will serve as Project Engineer. In this capacity, Mr. Patterson will support the evaluation of data collected at the site, with particular emphasis on the continuing evaluation of potentially applicable corrective measures. Mr. Patterson has over 11 years of experience in the design and implementation of remedial actions for environmental projects.

Mr. Michael Gonshor, P.G., Senior Hydrogeologist at Roux Associates, Inc., will serve as Project Hydrogeologist. Mr. Gonshor will support the evaluation of the effectiveness of ground water remediation and conduct ground-water fate and transport modeling. Mr. Gonshor has 15 years experience in design, implementation and management of environmental investigation and remediation projects.

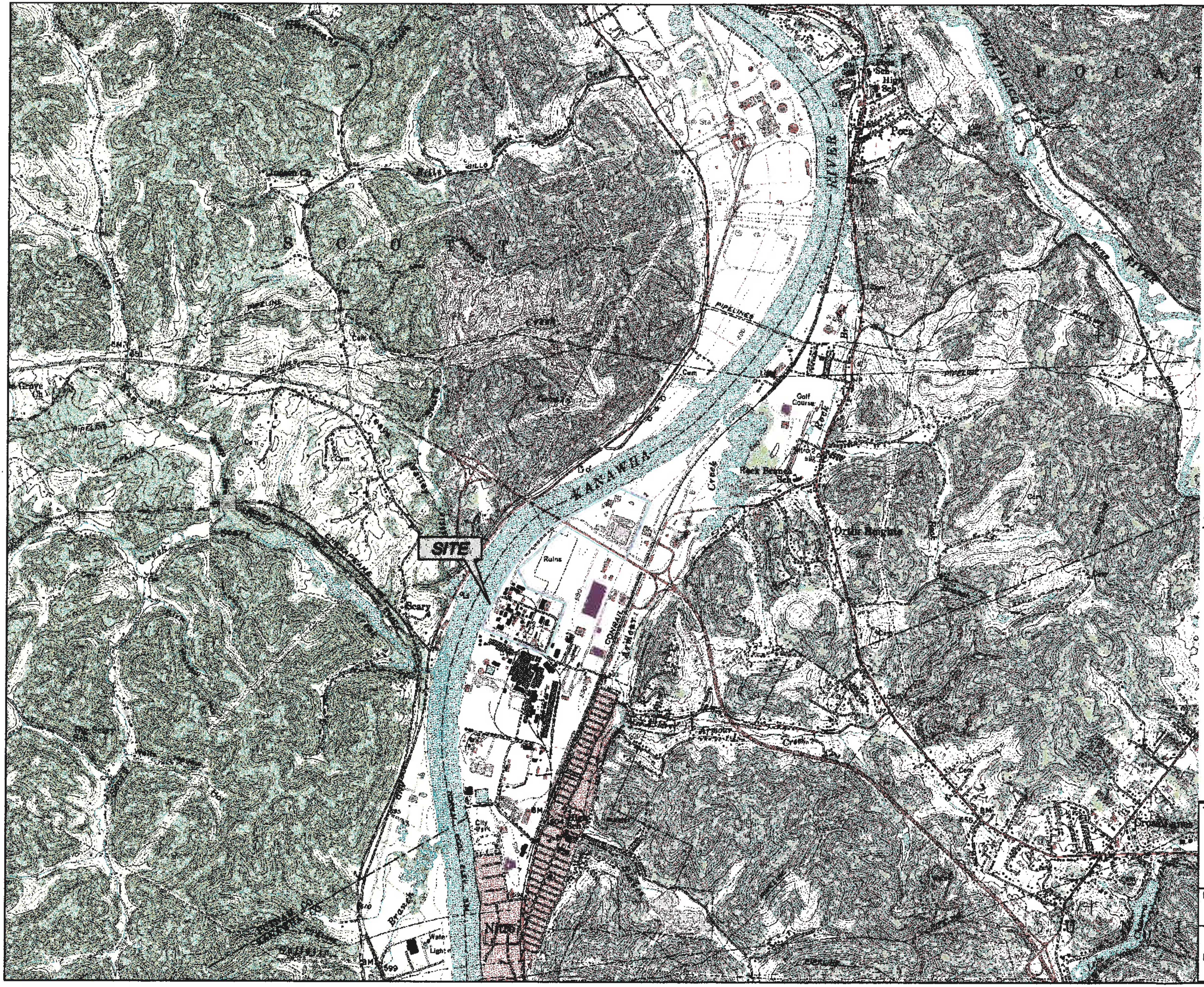
Key contacts for the facility and regulatory agencies responsible for overseeing the CMS and contracted services are listed below:

Facility Contact:	Mr. Anthony C. Tuk Solutia Inc. 1 Monsanto Road Nitro, West Virginia 25143
USEPA Contact:	Ms. Jennifer L. Shoemaker USEPA Region III 1650 Arch Street Philadelphia, Pennsylvania 19103-2029
CMS Report:	Mr. Camille Costa, P.E. Roux Associates, Inc. 1222 Forest Parkway Suite 190 West Deptford, New Jersey 08066 (856) 423-8800
Field Support:	Mr. Dennis Stottlemeyer Potesta and Associates, Inc. 2300 MacCorkle Avenue, S.E. Cox Hall Charleston, West Virginia 25304 (304) 342-1400
Analytical Laboratory:	Mr. Ray Erickson Laboratory Manager Research Environmental and Industrial Consultants, Inc. P.O. Box 286 Beaver, West Virginia 25813 (800) 999-0105

7.0 SCHEDULE

A project schedule is included as Figure 2.

FIGURES



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SOURCE

U.S.G.S. SAINT ALBANS, W.VA. QUADRANGLE 1958
7.5 MINUTE SERIES
PHOTOREVISED 1971 & 1976

U.S.G.S. SCOTT DEPOT, W. VA. QUADRANGLE 1958
7.5 MINUTE SERIES
PHOTOREVISED 1989

QUADRANGLE LOCATION

2,500' 0' 2,500'

Title:

SITE LOCATION MAP

NITRO, WEST VIRGINIA

Prepared For:

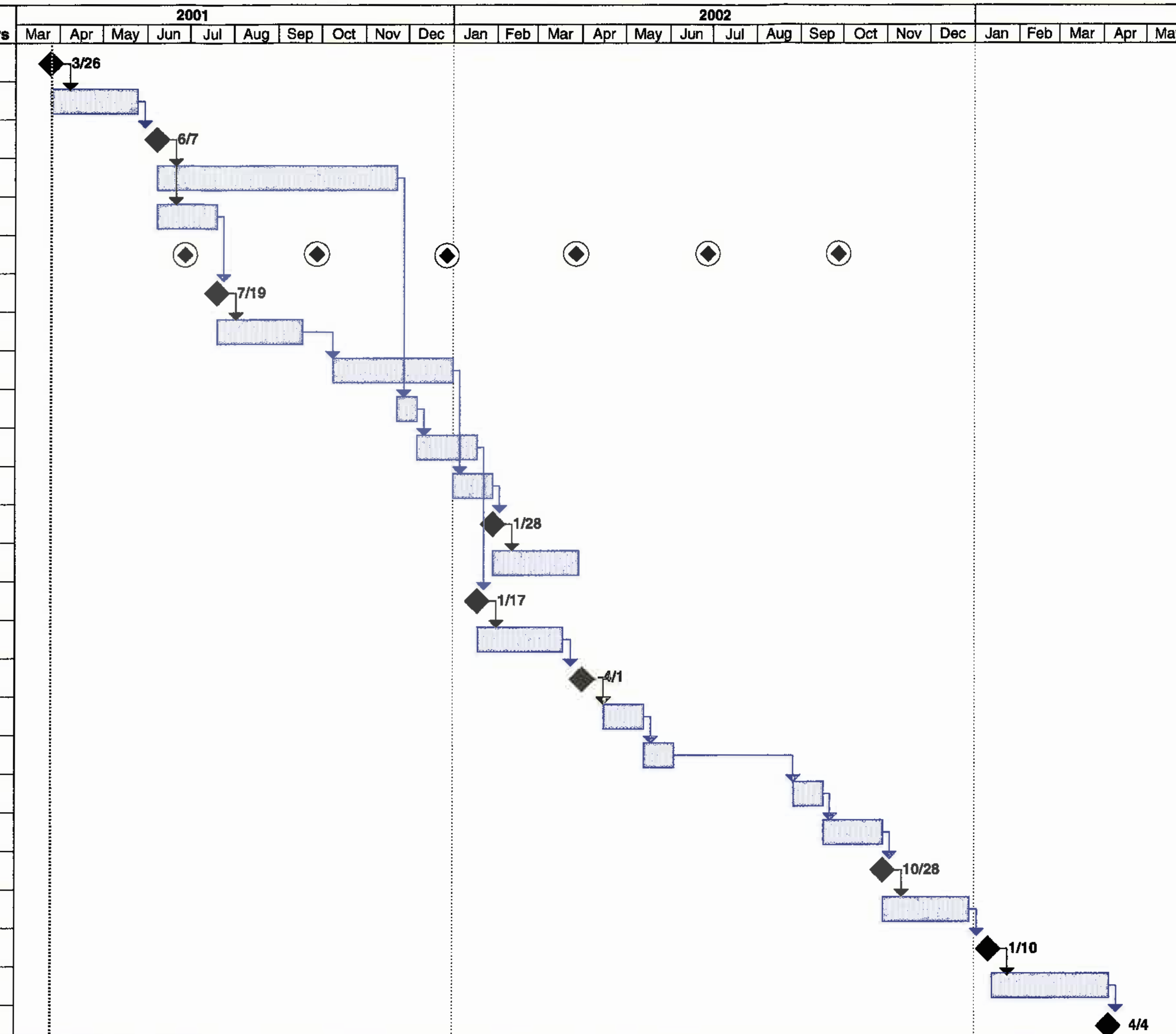
SOLUTIA

ROUX
ROUX ASSOCIATES, INC.
Environmental Consulting & Management

Compiled by: T.J.P.	Date: 04/06/00	FIGURE	
Prepared by: A.T.S.	Scale: AS SHOWN	1	
Project Mgr: C.C.	Office: NJ		
File No: 06619155	Project: 06619J06		

Figure 2
Solutia-Nitro, WV
Corrective Measures Study Work Plan Implementation Schedule

ID	Task Name	Duration	Start	Finish	Predecessors
1	CMS Work Plan Submission	0d	3/26/01	3/26/01	
2	USEPA Review of CMS Work Plan	60ed	3/26/01	5/25/01	1
3	CMS Work Plan Meeting	0d	6/7/01	6/7/01	2FS+10d
4	Preliminary Data Evaluation	24w	6/8/01	11/22/01	3
5	Prep. LNAPL Area Interim Corrective Measures (ICM) Plan	6w	6/8/01	7/19/01	3
6	**Quarterly Progress Report Submission**	**327d**	**6/28/01**	**9/28/02**	
13	LNAPL Area ICM Plan Submission	0d	7/19/01	7/19/01	5
14	USEPA Review of LNAPL Area ICM Plan	60ed	7/20/01	9/18/01	13
15	LNAPL Area ICM Implementation	12w	10/9/01	12/31/01	14FS+15d
16	Well Survey	10d	11/23/01	12/6/01	4
17	Prep. Supplemental GW Sampling Plan	30d	12/7/01	1/17/02	16
18	Prep. LNAPL Area ICM Report	4w	1/1/02	1/28/02	15
19	LNAPL Area ICM Report Submission	0d	1/28/02	1/28/02	18
20	USEPA Review of LNAPL Area ICM Report	60ed	1/29/02	3/30/02	19
21	Supplemental GW Sampling Plan Submission	0d	1/17/02	1/17/02	17
22	USEPA Review of Supplemental GW Sampling Plan	60ed	1/18/02	3/19/02	21
23	Supplemental GW Sampling Plan Meeting	0d	4/1/02	4/1/02	22FS+10d
24	Well Redevelopment & Repair	20d	4/16/02	5/13/02	23FS+10d
25	Supplemental GW Sampling - Round 1	15d	5/14/02	6/3/02	24
26	Supplemental GW Sampling - Round 2	15d	8/27/02	9/16/02	25FS+12w
27	Prep. Supplemental GW Sampling/Modeling Report	6w	9/17/02	10/28/02	26
28	Supp. GW Sampling/Modeling Report Submission	0d	10/28/02	10/28/02	27
29	USEPA Review of Supp. GW Sampling/Modeling Report	60ed	10/29/02	12/28/02	28
30	Supplemental GW Sampling/Modeling Report Meeting	0d	1/10/03	1/10/03	29FS+10d
31	Prepare CMS	12w	1/13/03	4/4/03	30
32	CMS Submission	0d	4/4/03	4/4/03	31



Project: Solutia-Nitro CMS Work Plan
Date: 3/26/01

Task | Milestone | Rolled Up Milestone

APPENDIX A

USEPA LETTER DATED JANUARY 18, 2001

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029

DRAFT

January 18, 2001

<u>CERTIFIED MAIL</u>
<u>RETURN RECEIPT REQUESTED</u>

Mr. Anthony Tuk
Nitro Coordinator
Solutia, Inc.
1 Monsanto Road
Nitro, WV 25143

Re: Corrective Measures Study Requirements
Solutia, Inc. Facility
EPA ID No. WVD033990965

Dear Mr. Tuk:

Thank you for meeting with EPA to discuss the Corrective Action activities at the Solutia facility. As the new project manager, it was helpful for me to have an update on the status of the ongoing work. The main purpose of the December 7, 2000 meeting and the January 5, 2001 conference call was to discuss EPA's August 16, 2000 letter which described the requirements for the next stage of the Corrective Action process. The letter requested that a Corrective Measures Study (CMS) be implemented to address areas of the facility that require remediation.

Based on the discussions between EPA and Solutia, EPA agreed to clarify particular items in the August 2000 letter to document our verbal agreements concerning areas needing attention during the CMS process.

It was agreed during our discussions that the sewer system stabilization measures currently being implemented by Solutia would be adequate to eliminate future releases of process wastewater from the unit. Due to the close proximity of equipment in the Process Area, it will be difficult to identify individual source areas from past releases that have contributed to the trichloroethylene (TCE) groundwater plume. Therefore, the requirements discussed in the section entitled "*Evaluation of potential remedies for existing sewer system*" in the August 2000 letter may be eliminated from the CMS submittal. Also, under the section heading "*Evaluation of potential remedies for VOC Plume - TCE Hot Spot Area*", the requirement specified in the second bullet ("Evaluate source control remedies for all sources which contribute to the site-wide

TCE contaminant plume or other VOC plume.") may be eliminated from the CMS report for the TCE Hot Spot Area. Sources that may be contributing to groundwater contamination in other areas of the site should be addressed as specified in the letter. However, the groundwater remedy evaluation for the Process Study Area will need to ensure that any contaminants mobilized by utilizing the existing sewer system as a stormwater management conduit is addressed by the selected remediation alternative and meets EPA's long term objectives for final cleanup.

As described in more detail in EPA's August 2000 letter, two major areas for study in the CMS remain: site-wide groundwater and past land-based disposal units such as the Niran Residue Pit, water filled depression in the Past Disposal Area, Tepee Incinerator and other areas that may be contributing contaminants to the groundwater. The specific requirements for the CMS are described in the August 2000 letter, as well as in the Corrective Action Permit.

Solutia may choose to complete the CMS process in a phased approach to prioritize the activities. Within sixty (60) days upon receipt of this letter, Solutia must submit a schedule and outline describing how Solutia plans to implement the CMS activities. Please feel free to contact me at the above address or at (215) 814-2772 with any questions.

Sincerely,

Jennifer L. Shoemaker
Remedial Project Manager

cc: Robert Greaves, EPA
Ruth Prince, EPA
Joel Hennessy, EPA
Yvette Hamilton-Taylor, EPA
Mike Dorsey, WVDEP
Tom Fisher, WVDEP

APPENDIX B

PROFESSIONAL PROFILES

John R. Loper, P.E.
Executive Vice President/Principal Engineer

Technical Specialties:
Strategic Planning, Process Design and Evaluation, Liability/Risk Management, Regulatory Agency Negotiations, Permitting and Compliance Audits, Waste Minimization and Control.

Experience Summary:
25 years of experience: Executive Vice President of Roux Associates, Inc.; Business Director of FMC Aquifer Remediation Systems and variety of environmental, manufacturing, marketing and safety positions at FMC Corporation. Directed and participated in CERCLA RI/FS/RD projects, RCRA closures and corrective action program projects, property transfer investigations and cleanups, NPDES audits and SARA Title III evaluations, waste minimization and pollution prevention surveys, air permitting and environmental impact studies, emissions control design and operation, HS&E compliance audits, regulatory agency negotiations, and expert witness testimony.

Credentials:
M.S. Chemical Engineering, West Virginia College of Graduate Studies, 1979.
B.S./B.A. Chemical Engineering/Applied Science, Lehigh University, 1973, with Honors.
Professional Engineer (TX, LA, AL, GA, PA, NJ, NY, DE, NC, and OH)
Licensed N-2 Industrial Wastewater Treatment System Operator (NJ)
Certified to perform UST Services (TX, LA, and NJ)
TNRCC Corrective Action Project Manager (CAPM No. 01061)
29 CFR 1910.120 OSHA HAZWOPER Training (40 hours basic, 8 hours supervisory and 8 hours annual refresher)
Tau Beta Pi (Engineering Honors Society)
Phi Beta Kappa (National Honors Society)
Who's Who in Finance and Industry (1993), in the East (1992), and Among Rising Young Americans in American Society and Business (1992)
Registered Site Manager (RSM): North Carolina

Professional Affiliations:
National Society of Professional Engineers
American Institute of Chemical Engineers
National Ground Water Association
Environmental Law Institute
American Water Works Association
Water Environment Federation
National Association of Corrosion Engineers
Association of Chemical Industry of Texas
Texas EnviroMentor Volunteer and Member of Advisory Board
AIChE Catalyst

Publications:
Real World Tips from a Veteran Oil Marketer, U.S. Oil Week Seminar, 1993
A Guide to ECRA, 1986
In-Situ Treatment of Ground Water, Hazardous Materials Spills Conference, 1986
In-Situ Ground-Water Remediation, Hazpro Conference, 1985

Key Projects:
- Principal-in-charge for strategic partnership with major chemical manufacturer to manage environmental liabilities and reduce remediation costs.

- Principal-in-charge for managing expansion and conversion of captive industrial landfill to approved municipal solid waste landfill, resulting in elimination of closure liability and sale of permitted air space.

- Principal-in-charge for design and operation of numerous ground-water, soil and air treatment systems. System components have included ground-water pumping, air sparging, vapor extraction, catalytic/thermal oxidation, ion exchange, UV oxidation, thermal desorption, and *in-situ* biological and chemical treatment processes. Constituents treated have included chlorinated solvents, petroleum hydrocarbons, coal tar chemicals,

John R. Loper, P.E.
Executive Vice President/Principal Engineer

polychlorinated biphenyl (PCB) compounds, pesticides, and heavy metals.

- Principal-in-charge for conducting environmental, health and safety compliance audits, SARA Title III evaluations and waste minimization studies for SOCMI clients.
- Principal-in-charge for developing air emission inventories and permitting for batch and continuous chemical, pharmaceutical and heavy manufacturing processes.
- Principal-in-charge for RCRA closure projects, post-closure monitoring programs, corrective action program facility investigations (RFIs), corrective measures studies (CMSs), and remedy implementation projects.
- Principal-in-charge for CERCLA and state-listed site emergency response actions, remedial investigations (RIs), feasibility studies (FSs), remedial designs (RDs), and remedy implementation projects for private-sector clients nationwide.
- Principal-in-charge for challenging proposed NPL listings of former chemical manufacturing plant and watershed area under Superfund.
- Principal-in-charge for business acquisition and divestiture due diligence evaluations, property transfer audits, investigations and cleanup programs for chemical, pharmaceutical, petroleum, and manufacturing clients.
- Principal-in-charge for investigation and remediation of petroleum hydrocarbon contamination problems at more than 50 distribution terminals and retail gasoline stations.
- Negotiated air, water, and solid/hazardous waste matters with USEPA and regulatory agencies in AL, AK, CA, CT, DE, FL, GA, LA, MA, MD, NC, NJ, NY, OH, PA, SC and TX.
- Provided litigation support and expert witness testimony for private-party suits and insurance matters involving the release of hazardous materials.
- Served as testifying expert in patent claim dispute regarding *in situ* oxidation technologies.
- Directed new business venture to develop and commercialize *in-situ* biological and chemical treatment technologies for contaminated soils and ground water.
- Conducted health and safety audits and process hazard reviews for 21 mining, chemical, manufacturing, and distribution facilities throughout the United States.
- Directed technical support for start-up of $10MM pollution abatement project to meet NPDES discharge requirements at a chemical manufacturing facility.
- Provided technical support for development of carbide lime recycle and recovery program to address former disposal and stormwater runoff problem for gas manufacturers.
- Principal-in-charge for design and construction of constructed wetlands systems to passively treat industrial wastes.
- Principal-in-charge for conducting OSHA Process Safety Management (PSM) and Mechanical Integrity (MI) audits at chemical manufacturing facilities.

Camille K. Costa, P.E.
Principal Engineer

Technical Specialties:
Investigation and remediation of Superfund sites and RCRA facilities. Regulatory compliance audits, permitting and contingency planning. Design and evaluation of landfills, sewer lines and water distribution systems.

Experience Summary:
21 years of experience: Principal Engineer at Roux Associates, Inc.; Engineering Manager at Environmental Science and Engineering; Engineering Manager at Dynamac Corporation; Project Engineer at Roy F. Weston; and Deputy Engineering Manager at Ameron Saudi Arabia Ltd.

Credentials:
B. S. Civil Engineering, American University of Beirut, 1978
Undergraduate Studies, Business Administration, California Baptist College
Licensed Professional Engineer (PA, NJ, DE)
New Jersey Certified for UST Installation, Closure and Testing
New Jersey Certified for Subsurface Evaluation

Professional Affiliations:
American Society of Civil Engineers

Key Projects:

- Deputy Program Manager for over 30 work assignments at more than 20 RCRA facilities under the $20 million USEPA Region III TES VIII contract. Responsibilities included providing senior QA/QC and technical review, monitoring costs and schedule for projects and overall program, tracking subcontract costs and performance, preparing monthly costs and budget analysis, and producing monthly progress reports. Project types included RFI/CMS, environmental audits, community relations and other support functions.

- Project Manager and Principal Engineer for a RCRA Corrective Action project at a large chemical manufacturing facility in West Virginia. Project includes: a $15MM sewer stabilization and rehabilitation program; a $0.5MM RFI and a $0.5MM CMS.

- Engineering Task Manager performing a detailed remedial alternative analysis for refinery in New Jersey undergoing a RCRA Corrective Action. Project includes a $2 MM sewer stabilization rehabilitation program, a 1 MM RFI which assessed 42 various SWMUs. The facility was primarily impacted by VOCs and PAHs in soils and ground water. Potential remedies included incineration, ground-water extraction and treatment, and soil vapor extraction.

- Engineering Task manager for the preparation of a CMS Report of a RCRA Corrective Action project at an 11-acre metals finishing facility in South Carolina. Soils, ground water, surface water and sediments are impacted by chlorinated VOCs and metals. The RCRA Facility Investigation has identified ground-water contamination in two aquifers. Interim Corrective Measures have been implemented and include landfill closure, lagoon closure and ground-water extraction.

- Project Manager for remediation of a Pennsylvania Superfund landfill impacted with metals and volatile organics. Project included design of an 80 gpm ground-water extraction and remediation system involving: phase separation, air stripping, solids filtration/precipitation and an ion exchange unit. Total project design costs are estimated at $0.5 MM. Project also included retrofitting existing leachate collection system. Coordinated the various design stages with EPA Region III and Pennsylvania Department of Environmental Protection.

- Project Manager for remediation of a 15 acre closed New Jersey facility impacted with metals and VOCs. The facility had an Administration Consent Order with the NJDEP to conduct soil remediation at the site. Activities conducted included:

  - Collection of additional samples.
  - Obtaining the necessary permits from state and local authorities.
  - Investigation of a buried drum area.
  - Demolition of a building impacted with lead-based paint and asbestos.
  - Excavation and/or capping of impacted areas.
  - Restoration of remediated areas.
  - Preparation of Remedial Action Report.

  The bulk of excavation was conducted in wetlands areas. As such, the project required close coordination with the regulatory agencies to ensure proper wetland mitigation and restoration.

- Project Manager for over 20 work assignments involving NPL sites as part of the $20 million USEPA TES VIII contract. Responsible for technical evaluation of Remedial Investigation (RI)/Feasibility Study (FS), Remedial Design (RD)/Remedial Action (RA) documents as prepared by PRPs. Completed reviews for the following sites:

  - Eastern Diversified Metals; Hometown, PA - RI Report, FS Report, RD Report.
  - Fischer & Porter; Warminster, PA - Focused Feasibility Study, RA Work Plan, RA Report.
  - Occidental Chemical; Pottstown, PA - RI Report, FS Report.
  - Delaware City PVC Plant; Delaware City, DE, RI Report, FS Report, RD Report. Also responsible for generating a 5-year remedy evaluation report.
  - Dover Gas Light; Dover, DE - RI Report, FS Report.
  - E.I. DuPont; Newport, DE - RI Report, FS Report.
  - Michaelsville Landfill; Aberdeen Proving Ground, MD - Concept Design Report and Estimate for a Landfill Cap and Cover System.
  - Bell Landfill; Tawanda, Pennsylvania, RI Report, FS Report

Thomas J. Patterson, E.I.T.
Senior Engineer/Office Health and Safety Manager

Technical Specialties:
Mechanical Engineering; soil and ground-water investigations; design of production, monitoring, observation and recovery wells; design and construction of public water treatment, industrial wastewater treatment and soil/ground-water remediation systems; design of vertical turbine, submersible, centrifugal, and positive displacement pumping systems; design and implementation of bioremediation plans; construction and project management; cost estimating.

Experience Summary:
11 years experience: Senior Engineer at Roux Associates, Inc.; Senior Project Manager at A.C. Schultes, Inc. (NJ and MD). Management and engineering responsibilities have included cost estimation to contract closeout of projects involving well design and installation, potable water, industrial wastewater and remedial treatment system plant design and installation, pump design and installation, mechanical design and installation, construction management of building construction, water storage structures, electrical, instrumentation and controls, mechanical, and chemical feed systems.

Credentials:
B.S., 1989, Mechanical Engineering, University of Bridgeport, Bridgeport, Connecticut
Completed First NGWA Regional Environmental Drilling and Field Investigations Course, 1992, University of South Florida, Tampa, Florida
OSHA 40-Hour Health and Safety Training
New Jersey Soil Borers License #B0328
New Jersey UST Closure & Subsurface Evaluator #0018850
E.I.T. (Engineer In Training) Certification

Professional Affiliations:
American Society of Mechanical Engineers

Key Projects:

- Preparation of a feasibility study (FS) addendum for the remediation of soil and ground water at a Superfund Site in Maywood, New Jersey. The FS addendum was prepared as a result of successful bioremediation and phytoremediation pilot study work and in an effort to gain a re-issuance of a USEPA ROD to include these technologies. The FS addendum included a new remedial alternative involving a three-phased approach to remediate soil and groundwater contaminated with volatile organic compounds. The three-phased remedial approach included in-situ soil bio-augmentation using faculative anaerobes and nutrients to degrade source area contamination, enhanced natural degradation of ground-water contamination through ORC injection, and downgradient hydraulic control through phytoremediation that included the planting of approximately 380 hybrid poplar trees to supplement the 610 poplar trees planted as part of the pilot study. The remedial selection was also influenced by elemental phosphorus and radioactive contamination at the site. The FS addendum provided the client with a USEPA-approved remedial alternative at a minimum net present worth cost savings of approximately 1.7 million dollars.
- Preparation of a feasibility study (FS) for the treatment of process and laboratory wastewater at a pharmaceutical manufacturing facility in West Deptford, New Jersey. The FS was prepared to evaluate treatment alternatives for wastewater containing acetone, toluene, and methyl isobutyl ketone (MIBK) above the categorical pretreatment standards for pharmaceutical manufacturing and above local POTW permit limits. A variety of physical, chemical, and biological treatment processes were evaluated to provide a viable and cost-effective wastewater treatment solution to the client. At this time, the client is evaluating the treatment train options analysis so that Roux Associates, Inc may complete the final wastewater treatment design.
- Designed, coordinated, and performed soil vapor extraction (SVE)/air sparge (AS) pilot testing, prepared a remedial action work plan (RAWP), and, as a result of New Jersey Department of Environmental Protection (NJDEP) approval of the RAWP, designed and constructed a full scale SVE/AS system to remediate BTEX-contaminated soil and ground water at the site as part of a voluntary underground storage tank (UST) remediation project.
- Provided engineering support and continuous monitoring and maintenance of a 100 SCFM soil vapor extraction system in Millville, NJ for a private retail gasoline supply company. System components include two soil vapor extraction wells, a 2 hp regenerative blower, a 100 SCFM catalytic oxidizer, and related control and electrical apparatus. Ongoing system monitoring and maintenance is performed for state regulatory compliance.
- Provided engineering oversight, field support, and coordination for a petroleum impacted soils corrective action at an asphalt processing plant in Morehead City, NC. Tasks included field support and post-excavation soil sampling for the removal and off-site thermal treatment of over 2300 tons of petroleum-impacted soils, engineering oversight for the demolition of a kerosene dispenser system, and the completion of a complete corrective action report for submission to the North Carolina Department of Environment, Health and Natural Resources.
- Design and implementation of an enhanced bioremediation and phytoremediation pilot study program for a chemical manufacturer in Maywood, New Jersey. Tasks included calculation of contaminant mass in ground water and soil, calculation of Oxygen Release Compound (ORC) mass required for effective ground-water bioremediation, design of optimum ORC slurry boring locations and injection depths, preparation of a site specific health and safety plan as well as a monitoring protocol involving volatile organics, metals, pyrophoric waste, and radioactive wastes, and project management support for the application of biomass and nutrients to contaminated soil. Tasks also included project management support with respect to the installation of trees and nutrients required as part of the phytoremediation pilot study.

Michael Gonshor, P.G.
Senior Hydrogeologist

Technical Specialties:
Design, implementation, and management of environmental investigation and remediation projects, design and analysis of aquifer pumping tests, ground water fate and transport modeling, preparation and review of expert reports in support of litigation/mediation, supervision of field activities, preparation and presentation of technical reports, evaluation of the effectiveness of ground-water remediation on actual ground-water cleanup, client and regulatory agency interface, ground-water flow and fate and transport modeling, data evaluation and presentation, remediation system conceptual design, evaluation and O&M.

Experience Summary:
15 years of experience: Senior Hydrogeologist, with Roux Associates, Inc.; previously Senior Hydrogeologist/Head of Hydrogeology at RT Environmental Services, Senior Hydrogeologist at Rare Earth Envirosciences, Project Geologist at BCM Engineers, and Laboratory Analyst at BCM Engineers.

Project manager and field team leader for several USEPA CERCLA RI/FS and RCRA RFI/CMS projects, including preparation of work plans and technical reports. Designed, managed, and implemented numerous State-lead investigative and remedial activities in Pennsylvania (under Act 2), New Jersey (ISRA projects), as well as projects in Connecticut, Massachusetts, North Carolina, Texas, and Virginia. Involved in several expert reports and litigation/mediation support cases.

Credentials:
B.S. Earth Science, Specializing in Geosciences, The Pennsylvania State University, 1985. Senior Research Paper – *Ground Water Monitoring*.
Graduate Course: Modeling Ground Water Flow - June 1994. Wright State University.
Registered/Licensed Professional Geologist: Pennsylvania, Delaware, North Carolina, and Virginia.
New Jersey-Licensed Subsurface Evaluator.

Key Projects:

- Senior Hydrogeologist with primary responsibility for geologic/hydrogeologic interpretations and ground-water flow and fate and transport modeling for support of CERCLA cost recovery project for an NPL Site in central New Jersey. Project activities include the planning and oversight of remedial investigations to identify the source, fate and transport of chlorinated VOCs in soil and ground water. Presented results of the geologic/hydrogeologic interpretations and ground-water flow and fate and transport modeling to the NJDEP and lawyers and consultants for opposing party. Also reviewed, evaluated, and commented on the plaintiff's consultants technical report regarding remedial investigation results and conclusions.

- Technical manager and ground water modeler for a State-lead soil and ground water investigation and remediation project for a circuit-board manufacturing facility in New Jersey. Soils and ground water at the site were impacted by former operations waste-water sludge lagoons and an unlined sulfuric-acid pit. The sulfuric acid pit was used in the 1940's-1960's to dissolve copper for reclamation. Since the pit and several lagoons were unlined, acid and dissolved metal migrated directly to the soils and underlying ground water. This resulted in a lowering of ground water pH to around 2 and leaching of metals to the ground water. The impacted aquifer, the Potomac-Raritan-Magothy (PRM) aquifer, was a significant concern, as this aquifer is a major source of water supply in New Jersey.

- Senior Hydrogeologist in charge of interpreting and presenting hydrogeologic information for a permit to deepen a large quarry in Pennsylvania. Interpreted regional-geologic and hydrogeologic conditions, and evaluated how increased dewatering due to deepening would potentially affect regional groundwater elevations. Of particular concern was if the increased regional cone of depression might induce flow of contaminated groundwater from area CERCLIS Sites into the quarry. Also presented findings in a televised public meeting to the Township's Environmental Advisory Council.

- Senior Hydrogeologist/Project Manager for numerous soil and groundwater remediation projects. Soil remediation projects involved delineating the extent of impacted soil, soil excavation oversight, waste characterization, arrangement for transportation and disposal of impacted soil, on-site pretreatment of soil highly impacted with volatile organic compounds, in-situ bioremediation, post-excavation sampling, data interpretation, and report preparation. Ground water remediation projects included conceptual design, installation, and testing of air sparging/soil vapor extraction (AS/SVE), Liquid-Ring Pumping (LRP), and In-Situ Bioremediation pilot- and full-scale remediation systems. Evaluated pilot-system results to determine if a full-scale system would be both cost effective and attain sufficient mass removal rates to effectively remediate impacted groundwater and soil in a reasonable time period. Several remediation system groundwater recovery designs included bedrock groundwater recovery.

- Designed, constructed, and calibrated a three-dimensional groundwater flow models using MODFlow and Visual MODFlow at a RCRA Facility in Pennsylvania, an ISRA site in New Jersey and a Superfund Site in New Jersey. Responsibilities included grid design, boundary determination, model construction and calibration, collection and interpretation of site and regional geologic and hydrogeologic data, preparation of geologic maps, cross-sections, and ground water elevation contour maps, data file preparation. Models were subsequently used to optimize recovery well locations and pumping rates for ground water remediation systems.

- Project Geologist/Project Manager for a RCRA Facility Investigation in for an active chemical manufacturing facility in Pennsylvania (USEPA Region III). Responsibilities included preparation of the work plan, regulatory agency and client interface, and implementation of the work plan. The work plan addressed 38 individual solid waste management units (SWMUs) at the facility and incorporated data from several years of previously completed environmental investigations. Data from previous investigations was used to reduce the number of SWMUs requiring additional investigation.

- Prepared and implemented the scope of work for the groundwater investigation for the closure of the hazardous waste storage pads at a RCRA facility in Massachusetts. Responsibilities included preparing scope of work and cost estimates, scheduling, subcontractor coordination, oversight of field activities, budget management, and preparation of the technical report of the investigation results. Responsibilities also included interaction with the Massachusetts Department of Environmental Protection to obtain approvals of changes to the scope of work dictated by conditions encountered during field activities and well as client meeting to present the investigation results and discuss conclusions and recommendations based on those results.

PLATES

LEGEND

- EDGE OF WATER
- FENCE
- FORMER EXTENT OF NITRO DUMP AREA
- APPROXIMATE EXTENT OF LNAPL AREA ASPHALT CAP

NOTE

1.) DASHED CONTOURS EXHIBIT HEAVY FOLIAGE.

REFERENCE

1.) TOPOGRAPHIC MAP PREPARED BY TERRADON CORPORATION DATED 2/17/95.

SWMU IDENTIFICATION	
PROCESS STUDY AREA	WASTE TREATMENT STUDY AREA
FACILITY SEWER SYSTEM EQUALIZATION TANKS PAST DISPOSAL AREA NIRAN RESIDUE PITS TEEPEE INCINERATOR BUILDING 46 INCINERATOR	WASTEWATER TREATMENT PLANT EMERGENCY BASIN SURGE BASIN EQUALIZATION BASIN LIMESTONE BED WASTE POND DECONTAMINATED 2,4,5-T BUILDING CITY OF NITRO DUMP

400' 0' 400'

Title:

SITE PLAN SHOWING CMS WORK AREAS

SOLUTIA INC.
NITRO, WEST VIRGINIA

Prepared For:

ROUX ASSOCIATES, INC.
Environmental Consulting & Management

Compiled by: T.J.P.	Date: 03/23/01	PLATE
Prepared by: J.S.G.	Scale: AS SHOWN	1
Project Mgr: C.K.C.	Office: NJ	
File No: 06619157	Project: 06619J08	